MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

BEM 1014 – MATHEMATICS

(All sections / Groups)

8 FEBRUARY 2023
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE (5) pages** excluding cover page with **4 Questions** only.
2. Answer all **FOUR (4) questions**
3. The **MATHEMATICAL FORMULAE** are attached at the end of the question paper.

Question 1 (20 Marks)

a) Solve $2|10x - 3| = -10$. **(5 marks)**

b) Find an equation of a straight line that has y-intercept -2 and perpendicular to the line $3x + 2y + 7 = 0$. **(8 marks)**

c) Edry's Biking Company manufactures and sells bikes. Each bike costs RM50 to make, and the company's fixed costs are RM2000. In addition, Edry knows that the price of each bike is RM 150. Find:

i) The cost and revenue function. **(3 marks)**

ii) The breakeven quantity. **(2 marks)**

iii) The breakeven revenue. **(2 marks)**

Question 2 (20 Marks)

A carpenter makes shoe cabinets in two sizes, small and large. It takes 4 hours to build a large one and 2 hours to build a small one. The profit from a large shoe cabinet is RM60 and the profit from a small shoe cabinet is RM30. The carpenter can spend only 24 hours a week making shoe cabinets and must make at least 2 units of each size.

a) Formulate the linear programming (LP) problem that maximizes profit. **(6 marks)**

b) Graph the feasible region. **(7 marks)**

c) Find how many small and large shoe cabinets the carpenter should build to maximize the profit. **(7 marks)**

Question 3 (25 Marks)

a) Jalil borrowed RM1,100 from Shamsul five months ago. When he first borrowed the money, they agreed that he would pay Shamsul 5% simple interest. If Jalil pays her back today, how much interest does he owe her? **(2 marks)**

b) If you deposit RM5,000 into an account paying 3% annual interest compounded semiannually, how much money will be in the account after 5 years? **(6 marks)**

Continued...

c) An insurance company promises to pay Musa RM500 at the end of each month for the next 5 years due to his recent car accident. How much money should the insurance company invest now at 2.4%, compounded monthly, to guarantee that all the payments can be made?

(6 marks)

d) A retirement fund has \$5000 in the current account. Find the amount of each quarterly payment to be made into this retirement fund to accumulate \$200,000 in 20 years at 5% interest per year compounded quarterly.

(6 marks)

e) \$5000 is borrowed with repayment by means of annual payments of R at the end of each of 6 years. The loan has an effective annual interest rate of 4.5%. What is the payment amount?

(5 marks)

Question 4 (35 Marks)

a) Find the derivatives of $y = (x+2)^3(4x^5 - 1)$.

(4 marks)

b) Find the second derivative of $z = \ln(7 - x^3)$.

(4 marks)

c) Find the equation of the tangent line to the graph of $f(x) = x^3 - 9x$ at the point where $x = 1$. **(5 marks)**

d) A certain production function is given by:

$$f(x,y) = 3y^2 + xy - 10x^2 - 2y + x - 7.$$

where x is the unit of labor and y is the unit of production volumes. Find the marginal productivity of labor and the marginal productivity of production volumes when $x = 40$ units and $y = 5000$ units.

(4 marks)

e) Evaluate the integrals:

i) $\int \frac{\left(x^2 - \frac{1}{2}\right)^2}{x} dx$ **(4 marks)**

ii) $\int_{-2}^{5} f(x)dx$ given $f(x) = \begin{cases} x^2 - 2, & -2 \le x < 0 \\ \frac{1}{2}x + 2, & 0 \le x \le 4 \\ 0 & \textit{otherwise} \end{cases}$ **(5 marks)**

Continued...

f) Find the area of the shaded region bounded by the line $y = 2x + 3$ and the curve $y = x^2$ using integrals.

(4 marks)

g) In a company that producing car parts, the marginal cost function is given by:

$$C'(x) = 25 + 30x - 9x^2$$

where C'(x) is measured in ringgit per unit and x denotes the number of units car parts produced. The fixed cost incurred by the company is RM 55500. Find the total cost function.

(5 marks)

End of Questions.

MATHEMATICAL FORMULAE

Simple Interest

(i) Interest, $I = Prt$ (P = principal, r = interest rate, t = number of years)

(ii) Accumulated amount, $A = P(1 + rt)$

Compound Interest

(i) Accumulated amount, $A = P(1+i)^n$, where $i = \frac{r}{m}$, and $n = mt$

(m = number of conversion periods per year)

(ii) Present value for compound interest, $P = A(1+i)^{-n}$

Effective Rate of Interest

$$r_{eff} = \left[1 + \frac{r}{m}\right]^m - 1$$

Future Value of an Annuity

$$S = R\left[\frac{(1+i)^n - 1}{i}\right]$$ (S = future value of ordinary annuity of n payments of R dollars periodic payment)

Present Value of an Annuity

$$P = R\left[\frac{1-(1+i)^{-n}}{i}\right]$$ (P = present value of ordinary annuity of n payments of R dollars periodic payment)

Amortization Formula

$$R = \frac{Pi}{1-(1+i)^{-n}}$$ (R = periodic payment on a loan of P dollars to be amortized over n periods)

Sinking Fund Formula

$$R = \frac{Si}{(1+i)^n - 1}$$ (R = periodic payment required to accumulate S dollars over n periods)

Continued...

Basic Rules of Differentiation

(i) Chain rule: Derive $g[f(x)] = g'[f(x)]f'(x)$

(ii) General power rule: Derive $[f(x)]^n = n[f(x)]^{n-1} f'(x)$

(iii) Exponential function: Derive $e^x = e^x$

(iv) Derive $(e^u) = e^u[u'(x)]$ Logarithmic function: Derive $\ln x = \frac{1}{x}$

Derive $(\ln u(x)) = \left(\frac{1}{u(x)}\right)[u'(x)]$

Basic Rules of Integration

(i) Exponential function: $\int e^u du = e^u + C$

(ii) Logarithmic function: $\int\left(\frac{1}{u}\right) du = \ln u + C$

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